INTRODUCTION
SECTION I - SOIL EROSION PREDICTION

This section describes use of the Revised Universal Soil Loss Equation(RUSLE) for estimating sheet and rill erosion from rainfall in Vermont. The RUSLE is a management tool used to estimate soil losses by sheet and rill erosion on cropland, pastureland, woodland, idle land and on construction sites. The equation quantifies the effects of natural factors and cultural management and cropping practices in soil loss.

The purpose of the RUSLE is to predict long-term average soil losses in runoff from specific field areas under specified cropping and management systems. Because of unpredictable short-time fluctuations in the values of influential variables, the RUSLE is less accurate in predicting specific events than for predicting average soil losses over the entire cropping sequence.

The effectiveness of a particular land treatment alternative can be evaluated when the predicted soil loss for that treatment is compared with the soil loss tolerance "T" for the specific soil. Soil loss tolerances denote the maximum level of soil erosion that allow high levels of sustainable economic crop productivity. By using the RUSLE, numerous crop and tillage alternatives can be developed for a particular field or farm. These alternatives can be compared on the basis of predicted soil loss and they can also be evaluated for effectiveness using "T". This allows the operator to select his or her system based on the effectiveness to reduce soil loss, feasibility and economics.

The RUSLE is used in determining the need for cropland terraces and diversions when these practices are needed to reduce the slope length as defined in the RUSLE. In Vermont, since most slope lengths are generally less than 300 feet, the use of cropland terraces and diversions is generally not reflected by using the RUSLE. - However, in many instances, these practices are justified in the planning process because they are needed to handle concentrated surface flows with erosive velocities. This justification is a reflection of experience and professional judgment by the planner. Factors entering into the decision to use cropland terraces, diversions and even grassed waterways include: cropping system intensity, adherence or lack of adherence to the contour, soil depth and productivity, as well as the extent of tillage or no-till planting combined with crop residue management

Occasionally, small portions of fields identified during the planning process cannot be completely treated to meet all the RUSLE criteria due to topography or physical limitations. In these situations when water courses or sensitive areas are located down slope, either off site protection from siltation must be provided or additional land treatment must be utilized to minimize siltation. Such practices as crop residue management and the use of cover crops may compensate for the lack of other treatment.

Even when meeting "T", cropland immediately upslope (above) water courses or sensitive areas may require additional treatment during periods of low residue or crop cover. This is especially true during the part of a crop sequence when crops with high "C" values are utilized. This additional treatment could include the use and management of crop residues, cover crops, intercropping or by allowing a natural or seeded filter strip between the cropland and the water course or other sensitive area.

In summary, the RUSLE is an important tool in developing conservation plans which keep soil losses to acceptable levels when considering long term soil productivity. However, from a water quality perspective, small parts of a field that cannot be treated to meet "T" or that are upslope from water courses or critical areas, may require additional treatment. The use of cover crops, management of crop residues or the use of natural or seeded filter strips may be needed to assure protection of the water course or sensitive area from siltation or other forms of pollution from overland flow.

REVISED UNIVERSAL SOIL LOSS EQUATION (RUSLE)

The REVISED UNIVERSAL SOIL LOSS EQUATION is: A = RKLSCP where

A = estimated average annual soil loss in tons/acre/year.

R = rainfall/runoff factor which quantifies the effect of the raindrop impact as well as the amount and rate of runoff associated with the rain (based on long term rainfall records).

See Table R for appropriate county rainfall factors.

K = soil erodibility factor which is based on the combined effects of all soil properties that significantly influences erosion rates. The K factor of .32 represents an average of 32 tons of soil movement on an acre of continuous fallow on a 9 percent slope having a length of 72.6 feet with a rainfall factor of 100. In the RUSLE computer program, the K factor is used to obtain a climate adjusted K factor (called the Average Annual K Factor). Factors for each Climatic Zone have been calculated and rounded to the nearest half class for all possible K factors. A map of Climate Zones is in Figure 1. The Average Annual K Factors are included inthis section as well as behind the Soil Legend in Section II of the Vermont Technical Guide.

See Table K for appropriate factors for Vermont soils.

L = slope length factor which is determined by field measurement. Slope crop sequence, residue management including surface cover length is defined as the distance from the point of origin of overland flow (near but not necessarily at the top of the slope) to the point where sediment deposition begins or sheet flow enters a defined channel (concentrated flows, not necessarily at the bottom of the field slope). A change of vegetation or field boundary does not "necessarily" begin a new slope. Slope lengths may be shortened by using cropland terraces or diversions as appropriate, however, most diversions and cropland terraces will be needed to handle concentrated flows rather than to reduce sheet and rill erosion. In Vermont, most slope lengths will average from 100-250 feet. Generally, as slopes become steeper, slope lengths will decrease. Infrequently, where slopes are very uniform, their lengths may exceed 400 feet. Table L illustrates typical conditions with appropriate slope length.

S = slope gradient factor which is determined by measuring the average percent slope over the slope length. In some instances, where slopes are complex, slope gradients and lengths may need to be segmented.

See Table LS for determining the appropriate LS value.

THE L AND S FACTORS ARE THE MOST DIFFICULT DETERMINATIONS THE PLANNER MUST MAKE. THEY HAVE A SIGNIFICANT IMPACT ON THE PREDICTED SOIL LOSS. THEREFORE, THE PLANNER MUST CAREFULLY SELECT L AND S FACTORS "IN THE FIELD" THAT BEST REPRESENT FIELD CONDITIONS. ANY ONE USING THE USLE INDEPENDENTLY SHOULD HAVE FIELD TRAINING IN DETERMINING L AND S FACTORS.

C = cover and management factor which is the soil loss ratio of a specified crop management system to that of continuous fallow (bare ground). Factors affecting the value of C include: crop sequence, residue management including surface cover, canopy effects and tillage. Of particular significance is the relationship of the timing of these factors with respect to the annual erosive rainfall distribution (erosion index distribution or EI). The selection of numerous management techniques which affect the C value affords the planner an

almost unlimited selection of management alternatives that can be incorporated into cropping systems. However, operator limitations including (1) Management abilities or constraints: (2) Acceptance of new technology; and (3) Equipment availability may significantly limit viable alternatives for the operator. In addition to soil Loss, the planner must keep in mind integrated crop management (ICM) techniques as they relate to integrated pest management (IPM) and nutrient management (NM). The examples include the use of specific crop sequences to avoid specific weed, disease or insect problems; the use of cover crops for fall applied manure and the consideration of tillage methods and utilization of nutrients from manure.

In determining a C factor for a given rotation, C values for each specific crop for each year in the rotation are added and then divided by the number of years in the rotation. It should be noted that for double cropping, an average C value for that year includes both crops and that even though two crops are grown, they represent only 1 year of the rotation. Based on prior discussion, the RUSLE should NOT be used for predicting a single-year soil loss for a given crop. C Factors are grouped by climatic EI Distribution Zone. Vermont has two EI Distribution Zones, 112 and 113. See map in Figure 1 to determine what EI distribution zone C Factor to use.

See Tables C-1, C-2, and C-3 for C factors applicable to the most common crops and crop sequences in Vermont. Table C-2 includes values for hayland, pasture and idle land. In using Table C-2, for most pastures, even with minimal management, the percent ground cover will not be less than 50 percent and will generally range from 60-90 percent. Loafing areas without actively growing vegetation will be most accurately reflected by observing the ground cover plus canopy which in most instances will be in the range of 0-20 percent. Table C-3 is to be used for no-till corn silage into sod. Percent ground cover is not the controlling characteristic that keeps the "C" factor low. Consolidation of soil is the major factor.

For crops not shown, use similar crops and conditions or contact the NRCS State Resource Conservationist.